

TITLE OF THE INVENTION

PRINTED WIRING BOARD AND ELECTRONIC APPARATUS

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BACKGROUND OF THE INVENTION

## Field of the Invention

This invention relates to a printed wiring board a  
printed wiring board which is capable of preventing the  
10 occurrence of lift-off and land peeling at soldered  
portions when a component to be mounted on the printed  
wiring board (hereinafter referred to as the 'inserted  
component') is soldered by using solder, in particular  
lead-free solder, and an electronic apparatus such as a  
15 printer in which is installed the printed wiring board.

## Description of the Related Art

Soldering has conventionally been carried out  
using eutectic lead solder (Sn-Pb: melting point 183°C),  
20 but in recent years there have been demands for  
soldering to be carried out using lead-free solder due  
to environmental restrictions.

However, the high-temperature-type lead-free  
solders that are currently most commonly used are  
25 composed mainly of Sn and Ag, and have a melting point  
of about 220°C. If flow soldering of an inserted  
component is carried out using such a high-temperature-

type lead-free solder, then solidification of the solder, which is accompanied by solidification shrinkage, proceeds from the vicinity of the inserted component, which has good thermal conductivity, towards the vicinity of the printed wiring board, and hence the solder joint interface at the part of the surface of the substrate on which the inserted component is mounted in particular becomes the final solidified part, resulting in lift-off and land peeling.

Moreover, when flow soldering is carried out using lead-free solder as described above, segregation of Pb contained in the surface-treated leads of the inserted component and segregation of elements (Bi etc.) contained in the lead-free solder used in the flow soldering occur during the cooling process, and the physical properties of the solder change during the cooling process. As a result, there is a problem that the occurrence of lift-off and land peeling is increased, and in the worst cases the land peeling is accompanied by breakage (i.e. electrical disconnection) of the pattern connected to the lands.

To resolve such a problem, Japanese Laid-open Patent Publication (Kokai) No. 11-354919 discloses a method of improving countermeasures in the cooling step of the soldering process. However, there is a problem that a coolant must be used during the cooling, and hence the soldering cost rises.

FIG. 5 is a sectional view of a conventional example of a printed wiring board in which lift-off has occurred, and FIG. 6 is a sectional view of a conventional example of a printed wiring board in which land peeling has occurred.

In FIGS. 5 and 6, reference numeral 1 designates a substrate of the printed wiring board. A plurality of through holes 5 are formed in the substrate 1, and a land 6 is formed over an inner peripheral surface of each through hole 5 and opposite end surface parts of the substrate 1 formed with the through hole 5. Reference numeral 3 designates an inserted component such as an electronic component having inserted component leads 2. Each inserted component lead 2 is inserted into one of the through holes 5, and soldered to the substrate 1 with lead-free solder by flow soldering. Reference numeral 8 designates a solder resist.

In the case of a conventional printed wiring board on which lead-free soldering is carried out as described above, during the flow soldering the lead-free solder rises through each through hole 5 in a wet state, thus forming a fillet 7 between a mounting surface part of the inserted component 3 at which it is mounted onto the substrate 1 and the land 6. As a result, lift-off in which the fillet 7 between the mounting surface part of the inserted component 3 and

the land 6 does not join to the land 6 may occur as shown in FIG. 5, or the land 6 may peel off along with the fillet 7 as shown in FIG. 6.

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# SUMMARY OF THE INVENTION

It is an object of the present invention to provide a printed wiring board in which lift-off and land peeling do not occur during soldering of an inserted component onto the printed wiring board and hence pattern breakage does not occur, but with no increase in cost, and an electronic apparatus in which is installed the printed wiring board.

To attain the above object, the present invention a printed wiring board comprising a substrate having two opposite surfaces, a plurality of soldering through holes formed in the substrate so as to open in the opposite surfaces, for inserting leads of an inserted component to be mounted onto the printed wiring board and soldering the inserted component onto the substrate, each of the through holes having an inner peripheral surface, and a plurality of lands each formed continuously across the opposite surfaces and the inner peripheral surface of a corresponding one of the through holes, each land having a surface, and means for maintaining at least a part of the surface of each of the lands in a state not wetted by solder.

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In a preferred form of the present invention,  
 printed wiring board further comprises at least one  
 wiring pattern provided on at least one of the opposite  
 surfaces and connected to the lands, and wherein the  
 means maintains connection portions between the lands  
 and the wiring pattern in a state not wetted by the  
 solder.

Preferably, the means comprises a material not  
 wetted by the solder coated onto the lands.

10 More preferably, the material not wetted by the  
 solder is a solder resist.

Alternatively, the material not wetted by the  
 solder is a silk-printed pattern.

Also alternatively, the material not wetted by the  
 15 solder comprises a solder resist and a silk-printed  
 pattern laminated onto one another.

In another preferred form of the present invention,  
 the means comprises deactivation treatment means of  
 oxidizing at least a part of the surface of each of the  
 20 lands.

Preferably, the leads of the inserted component  
 have been treated with lead solder.

Also preferably, the inserted component is  
 soldered onto the substrate by flow soldering using  
 25 lead-free solder.

~~More preferably, the lead-free solder contains Bi.~~

To attain the above object, the present also

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provides an electronic apparatus in which is installed a printed wiring board as constructed above.

The above and other objects, features and advantages of the invention will become more apparent from the following detailed description taken in conjunction with the accompanying drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

10        FIG. 1 is a sectional view showing a printed wiring board having an inserted component soldered thereto with lead-free solder, according to a first embodiment of the present invention;

15        FIG. 2 is a sectional view showing a printed wiring board having an inserted component soldered thereto with lead-free solder, according to a second embodiment of the present invention;

20        FIG. 3 is a sectional view showing a printed wiring board having an inserted component soldered thereto with lead-free solder, according to a third embodiment of the present invention;

25        FIG. 4 is a sectional view showing a printed wiring board having an inserted component soldered thereto with lead-free solder, according to a fourth embodiment of the present invention;

FIG. 5 is a sectional view showing a conventional example in which lift-off has occurred;

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FIG. 6 is a sectional view showing a conventional example in which land peeling has occurred;

FIG. 7 is a plan view of a printed wiring board in which a solder resist has been partially applied onto a land, according to a fifth embodiment of the present invention;

FIG. 8 is a plan view of a printed wiring board in which a solder resist has been partially applied onto a land, according to the fifth embodiment of the present invention; and

FIG. 9 is a schematic see-through view showing the printed wiring board according to the present invention installed in a copying machine, which is an example of an electronic apparatus.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiments of the present invention will now be described in detail with reference to the drawings.

(First embodiment)

FIG. 1 is a sectional view showing a printed wiring board according to a first embodiment of the present invention in a state in which inserted component leads 2 have been flow-soldered to the printed wiring board with lead-free solder. In the present embodiment and the other embodiments described below, elements and parts corresponding to elements and

parts in FIGS. 5 and 6, which show the conventional art described above, are designated by the same reference numerals as in FIGS. 5 and 6.

Other components are mounted on the printed wiring board in actual practice, but these have been omitted from the drawings as they bear no direct relation to the essence of the present invention.

The printed wiring board of the present embodiment is installed into an electronic apparatus such as a printer or a copying machine.

In FIG. 1, a plurality of through holes 5 are formed in a substrate 1 of the printed wiring board, and a land 6 is formed over an inner peripheral surface of each through hole 5 and opposite end surface parts of the substrate 1 formed with the through hole 5. Inserted component leads 2 of an inserted component 3 such as an electronic component are inserted into the through holes 5 and flow-soldered to the substrate 1 with lead-free solder.

A silk-printed pattern 4 is formed on a major surface of the substrate 1 on which the inserted component 3 is mounted, so as to cover the lands 6 (specifically an end surface of each land 6 on the major surface side of the substrate 1) that are formed on the through holes 5 for soldering the inserted component 3 mounted on the substrate 1. Note that silk-printed patterns (not shown in the drawings) that

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show the types, positions and numbers of components mounted on the substrate 1 and circuit diagram numbers are printed in predetermined positions on the major surface of the substrate 1, and the silk-printed pattern 4 is printed at the same time as these silk-printed patterns using the same ink.

As described above, a silk-printed pattern 4 is interposed between the lands 6 and the inserted component leads 2 on the surface part of the substrate 1 on which the inserted component 3 is mounted. As a result, it is possible to carry out flow soldering such that fillets 7 are not formed between the inserted component leads 2 and the lands 6.

Consequently, according to the present embodiment, because fillets 7 are not formed between the leads 2 of the inserted component 3 and the lands 6, good soldering can be obtained in which lift-off and land peeling do not occur and hence pattern breakage does not occur.

FIG. 9 is a schematic see-through view showing the printed wiring board according to the present invention installed in a copying machine.

(Second embodiment)

FIG. 2 shows a second embodiment of the present invention. The constitution of the printed wiring board in the present embodiment is the same as in the first embodiment, with one change that the lands 6 are

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Consequently, according to the present embodiment,  
10 as in the first embodiment, because fillets 7 are not  
formed between the inserted component leads 2 and the  
lands 6, good soldering can be obtained in which lift-  
off and land peeling do not occur and hence pattern  
breakage does not occur.

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between the inserted component leads 2 and the lands 6,  
 it is possible to carry out flow soldering such that  
 fillets 7 are not formed between the inserted component  
 leads 2 and the lands 6.

Consequently, according to the present embodiment,  
 as in the first embodiment, because fillets 7 are not  
 formed between the inserted component leads 2 and the  
 lands 6, good soldering can be obtained in which lift-  
 off and land peeling do not occur and hence pattern  
 breakage does not occur.

(Fourth embodiment)

FIG. 4 shows a fourth embodiment of the present  
 invention. The constitution of the printed wiring  
 board in the present embodiment is the same as in the  
 first embodiment, with one change that deactivation  
 treatment is carried out in which a surface 9 of each  
 land 6 is oxidized to reduce the wettability to the  
 solder, rather than the lands 6 being covered by a  
 silk-printed pattern 4.

Even with this constitution, similar to the case  
 of the first embodiment, because the surfaces 9 of the  
 lands 6 between the inserted component leads 2 and the  
 lands 6 are deactivation-treated and thus not wetted by  
 the lead-free solder, it is possible to carry out flow  
 soldering such that fillets 7 are not formed between  
 the inserted component leads 2 and the lands 6.

Consequently, according to the present embodiment,

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as in the first embodiment, because fillets 7 are not formed between the inserted component leads 2 and the lands 6, good soldering can be obtained in which lift-off and land peeling do not occur and hence pattern breakage does not occur.

(Fifth embodiment)

FIGS. 7 and 8 show a fifth embodiment of the present invention in which a solder resist 8 is applied onto one or more parts of the end surface of each land 6 on the major surface side of the substrate 1 of the printed wiring board. In FIGS. 7 and 8, reference numeral 10 designates a wiring pattern extending out from each land 6.

According to the present embodiment, it is possible to prevent the solder resist 8 from entering into the through holes 5 resulting in the strength of joining of the inserted component 3 to the substrate 1 dropping, which may happen if the solder resist 8 is applied over the whole of the end surface of each land 6 on the major surface side of the substrate 1.

In the present embodiment, the solder resist 8 is applied onto a part where the end surface of each land 6 on the major surface side of the substrate 1 of the printed wiring board and the wiring pattern 10 are connected together. As a result, breakage of the wiring pattern 10 caused by stress on the lands 6 during the solder joining can be prevented.

Embodiments of the present invention have been described above, but the present invention is not limited to these embodiments. The present invention can be realized by providing any means for maintaining  
5 a state in which the surface of each of the lands formed in the through holes into which the inserted component is soldered are not wetted by the lead-free solder.

Moreover, the leads of the inserted component may  
10 have already been treated with lead solder, the printed wiring board may be, for example, a double-faced printed wiring board or a multi-layered printed wiring board, and/or the lead-free solder may contain Bi.

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